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Gradient Modelling

THESIS/
REPORTS
CATTELINO,
P.J.

Referance Base for Vegetative Response

and Species Reproductive Strategies

GRADIENT MODELING, INC.

STEPHEN R. KESSELL
President

PETER J. CATTELINO
Vice-President

MEREDITH W. POTTER
Systems Analyst

Reply to:

A Montana non-profit corporation devoted to ecological research and management application.

FINAL REPORT

for

Supplement No. 10 to Master Memorandum effective 6/25/76 between

INTERMOUNTAIN FOREST AND RANGE EXPERIMENT STATION

and

GRADIENT MODELING, INC.

A REFERENCE BASE FOR VEGETATIVE RESPONSE AND SPECIES REPRODUCTIVE STRATEGIES

Submitted by: Peter J. Cattelino Date 3/31/80
Peter J. Cattelino, Authorized
Principal Investigator

Recommended by: George E. Gruell Date 3/31/80
George E. Gruell, Research
Wildlife Biologist

Approved by: James K. Brown Date 4/1/80
James K. Brown, Project Leader

Box 2666
Missoula, Montana 59806

Box 5007
Riverside, California 92507

CSIRO Div. of Plant Industry
Canberra City, A.C.T. 2601, Australia

Box 147
West Glacier, Montana 59936

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Submitted by:

Peter J. Cattelino
Principal Investigator

March 31, 1980

RECEIVED

APR 23 1980

Intermountain Forest &
Range Experiment Station

A REFERENCE BASE FOR VEGETATIVE RESPONSE AND SPECIES REPRODUCTIVE STRATEGIES

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A REFERENCE BASE FOR VEGETATIVE RESPONSE AND SPECIES REPRODUCTIVE STRATEGIES

INTRODUCTION

Development of land management prescriptions requires a basic knowledge of the response of vegetation to the proposed activity. Activities such as prescribed fire, harvest, or thinning manipulate vegetation; the vegetative response on that site will determine, to a large extent, the future composition of the stand (Lyon and Stickney, 1976). This resulting vegetation is of concern in many aspects of land management from timber production to watershed quality, but perhaps of greatest interest are the effects of fire. The ability of fire to transform, enhance, and rejuvenate vegetation has been observed for many years (Leopold 1924, Weaver 1943). However, in dealing with vegetation on a site specific basis, information pertaining to vegetative response to fire is often not readily available, but rather it is dispersed through a wide range of professional journals, theses, and office reports. In an attempt to provide information on vegetative response to the land manager, a Vegetative Response Reference Base was developed through a cooperative effort between Gradient Modeling, Inc, and RWU-2108.

THE VEGETATIVE RESPONSE LIBRARY

The Vegetative Response Library is a collection of published work that contains post-disturbance response information on plant species found within the Intermountain West. The vast majority of the literature included is fire related, although harvest, thinning, and mechanical disturbances were also included if the vegetative recovery of the appropriate species was discussed. Similarly, papers that reported mechanisms of species survival and/or response

were added. These publications usually did not discuss vegetative response in relation to a particular disturbance, but refer to laboratory, germination, or other ecological studies. The Vegetative Response Library encompasses primarily the Intermountain West (Regions 1 and 4). Publications from other regions were included if they discussed species found with the Intermountain area and were appropriate to the objectives of this study (aspen is a good example). Consequently, many geographical regions are represented. This material can be used to supplement findings from the Intermountain area.

The quantity of information provided on species response within the Intermountain area is relatively small, especially that related to underburning in forested types. Most of the work has been conducted on wildfires, slash or broadcast burns. However, many of these studies do not relate burning conditions to the vegetative response. These studies primarily present pre- and post-fire data on vegetative cover and thus deal with the actual fire effects in an indirect manner. Additional information relating burning conditions, vegetative response mechanisms, and successional development following fire in Northern Rocky Mountain coniferous forests is needed. Similarly, vegetative response following various timber harvesting treatments should receive more attention in future studies. Current information provides a baseline for inference of successional trends but increased utilization of harvested sites in the future will demand that vegetation-harvest relationships be further refined.

Range and grassland species seem to have received more attention in fire and fire effects work than forest species. These studies often utilize prescribed fire to reduce competition, improve forage production, increase palatability, etc. Mechanisms of survival and vegetative response of these species are of concern because of the direct relationship between the vege-

tative recovery and range condition (and thus grazing capacity).

The Vegetative Response Library provides an excellent overview of vegetative recovery following particular disturbances. Research findings which will aid ecologically sound decision making are made available through the use of the library, thereby promoting better prescription development. More work is definitly desired, especially in the areas of underburning, species survival mechanisms, predicting direct fire effects, and successional trends.

In developing the Vegetative Response Library, a summary of species response to disturbance was formulated. This summary appears in Appendix 1. An individual species was included in the summary if the publication in which the species was discussed directly addressed the mechanism which allowed that species to persist through the disturbance. Additional entries were not made if similar responses were observed for that species in other papers. This summary is meant to provide a brief overview of vegetative response mechanisms; by utilizing the publications refered to in the summary, a user will be led to more detailed information on the species of interest. When used in conjunction with the FAMULUS SEARCH routine (see FAMULUS User's Manual -- attached), vegetative response information is very easy to obtain.

THE VEGETATIVE RESPONSE LIBRARY AND FAMULUS

This section describes acquistion, manipulation, and management of data derived from literature by accessing FAMULUS. It is meant as an aid to the FAMULUS User's Manual when utilizing the Vegetative Response File. The information presented here provides insight as to how the Vegetative Response File was developed along with tips for its access and maintenance. Always refer to The FAMULUS User's Manual before running any feature of FAMULUS. This report

does not supercede the FAMULUS User's Manual.

The Vegetative Response Library contains copies of over 340 publications gathered from various professional journals, theses, and office reports. Each is numbered consecutively and referenced by a Master Bibliography which is alphabetized by author. A system of keywords and phrases was developed from the content of the literature which are pertinent to plant response following disturbance. Each publication was also rated on a relative bases as to its appropriateness to the objectives of this study. This rating is included in each citation's keywords where:

1 = Best - Excellent in reference to objectives
2 = Good - Very appropriate to objectives
3 = Appropriate to objectives

A list of these keywords appears in both Appendix 2 and along with the Master Bibliography.

Citations and keywords were then organized and coded for computer storage in a form compatible with the data management system, FAMULUS (see FAMULUS User's Manual, page 24). Each citation (or record) was divided into sections (or fields) and ordered as follows:

FIELDS	FAMULUS FIELD LABEL
Author	AUTH
Date	DATE
Title	TITL
Publication	PUBL
Annotation	ANNO
Keywords	KEYS
Number	NUMB
A	A
B	B
C	C

The fields, Annotation, A, B, and C do not currently contain information, but but have been declared as available during creation of the file so that additional information from a publication could be added to a record if desired. See the FAMULUS User's Manual (page 24) for instructions in setting up record

fields and keypunching formats.

The keyword field (KEYS) has been declared as the descriptor field. The format of this field (terms separated by commas) allows INDEX and SEARCH to scan the field for multiple word terms. In addition, INDEX and VOCABULARY use the descriptor field as a default if no field is specified in the FAMULUS control cards. The author field (AUTH) has been coded in the descriptor field format to allow indexing by author. Examples of this format are:

```
KEYS FIRE, SMOKE, FUEL, FIRE EFFECTS, SMOKEY BEAR
AUTH SMITH J.D., DOE F.F., PUBLIC M.A.
AUTH JONES A.B.
```

The author field is therefore not in a form standard for published bibliographies. In addition, this format is necessary for correct alphabetic sorting of the file by the author field.

The number field (NUMB) contains the number of an individual publication contained in the Vegetative Response Library. It is the number that is used to locate a copy of a particular publication in the library. This number is not to be confused with the number assigned to a citation by FAMULUS. To illustrate, consider the following citation as printed by the EDIT feature of FAMULUS:

```
     266  AUTH SCHIER G.A.
          DATE 1980.
          TITL ROOT STEM CUTTINGS FROM ASPEN SEEDLINGS.
          PUBL USDA FOR. SERV. RES. NOTE INT-282, 4P. INTERMT. FOR. AND
               RANGE EXP. STN., OGDEN, UT.
          KEYS ASPEN, SEEDLINGS, ROOTS, SUCKERING, GROWTH, CLONE, UTAH, 2
          NUMB 266
                    Vegetative Response Library number
```

FAMULUS number

In this example the FAMULUS number and the Vegetative Response Library number correspond. After additional records are added to the file and the file is re-alphabetized, the two numbers will be different. The FAMULUS number will

change but the Vegetative Response Library number will always be a unique number which permanently corresponds to that particular publication in the library. The FAMULUS number on the other hand, has the potential to change each time the file is re-alphabetized. This number is used during computer access or when cross referencing citations through the keyword index. Citation numbers occurring in the keyword index are FAMULUS numbers. Thus, if a user finds that the keyword 'prescribed fire' occurs in citation 88, he must find FAMULUS citation 88 in the Master Bibliography and refer to the NUMB field of that citation to locate that publication in the Vegetative Response Library.

The Vegetative Response File is accessed by the 1977 version of FAMULUS which resides on the CDC 7600/6600 computer at the Lawrence Berkeley Laboratory Computer Center, Berkeley, California. Most of the FAMULUS features contained in the 1977 version of the system have been utilized in the development of the Vegetative Response File. Job Control language (JCL) and instructions for effecient use of the features utilized are contained in Appendix 3. This appendix should be used in conjunction with the FAMULUS User's Manual. Punched card decks of all features utilized are included with this report.

Retrieving information through FAMULUS requires the use of two magnetic tapes. One tape is always considered the Master Tape (TAPE1); that is, it contains the most current, up to date version of the Vegetative Response File. It is used as the input tape for all FAMULUS features. Both tapes are used when EDIT (except when used to get a listing of the file) and SORT are accessed. FAMULUS then makes changes to the contents of the Master Tape (TAPE1) and writes the updated file to the output tape (TAPE2). This output tape (TAPE2) then becomes the Master Tape (TAPE1) and thus the input tape for the next run. Since these tapes often change roles between various runs, it is imperative to keep an accurate record of which tape is the Master Tape (TAPE1). Failure

to do so may result in the destruction of part or all of the file. Only one tape is used, however, when EDIT is used to get a listing or SEARCH, GALLEY, INDEX, and VOCABULARY are accessed.

Perhaps the most powerful feature of FAMULUS is SEARCH which allows retrieval of information by keyword request. The extent to which this feature can retrieve desired information depends entirely upon the SEARCH Formula (see FAMULUS User's Manual, page 34). Thorough knowledge of the keywords (Appendix 2) is essential for efficient construction of the SEARCH Formula. Keywords used in the SEARCH Formula are joined by the logical operators AND, OR, and NOT. These operators are interpreted by the following card punch codes:

AND	∧	0-8-7 multipunch
OR	∨	11-0 multipunch
NOT	¬	12-8-6 multipunch

The negation (NOT) symbol is not interpreted correctly by the remote batch terminal at the Northern Forest Fire Laboratory. If this operator is determined to be useful in retrieving information, it may be necessary to move the Vegetative Response File to another computer facility. The FAMULUS system support personnel might also be contacted so that they might be made aware of the problem. A more commonly recognized symbol might be substituted for the one currently used. Until this situation is corrected do not attempt to use the negation operator in a SEARCH Formula as it causes the program to abort.

The result of a SEARCH is a list of citations that satisfy the conditions set within the SEARCH Formula. They are printed in the following format:

266 SCHIER G.A. 1980. ROOT STEM CUTTINGS FROM ASPEN SEEDLINGS. USDA FOR. SERV. RES. NOTE INT-282, 4P. INTERMT. FOR. AND RANGE EXP. STN., OGDEN, UT. ASPEN, SEEDLINGS, ROOTS, SUCKERING, GROWTH, CLONE, UTAH, 2 266

FAMULUS number

Vegetative Response Library number

Note that the Vegetative Response Library number appears at the end of the citation in a SEARCH printout and follows the rating number of the publication. Several examples of SEARCH runs appear with the Master Bibliography.

To aid in the construction of a SEARCH Formula, the keywords are listed in several different formats. Appendix 2 lists the keywords by subject matter. INDEX, which appears with the Master Bibliography, lists the keywords alphabetically along with the FAMULUS numbers of the citations in which they appear. And finally, an alphabetical list produced by VOCABULARY is attached to the Master Bibliography.

The Vegetative Response Reference Base, when used properly, will provide fast, effecient retrieval of plant response information. The following guidelines will be helpful when using this system:

1) Have a good idea of what type of information is to be retrieved;
2) Become familiar with the keywords - they are the language by which desired information is retrieved;
3) Become effecient in the construction of the SEARCH Formula;
4) Do not use the negation (NOT) symbol in a SEARCH Formula;
5) Keep an accurate record of which tape is the Master Tape (TAPE1); and most importantly,
6) Become intimately familiar with the FAMULUS User's Manual.

The development of the Vegetative Response Library and corresponding computer file required approximately 9 man months of work. Computer costs were roughly $210. with documentation of these costs filed with the ADP Coordinator, RWU-2110.

Many thanks are extended to the personnel of RWU-2108 and RWU-2110 for their professional input to this study. A special expression of gratitude is extended to Diane Kaplan for her hard work and dedication during this project.

LITERATURE CITED

Leopold, A. 1924. Grass, brush, timber, and fire in southern Arizona. J. For. 22:1-10.

Lyon, L. J., and P. F. Stickney. 1976. Early vegetal succession following large Northern Rocky Moutain wildfires. Tall Timbers Fire Ecol. Conf. Proc. 14:355-375.

USDA Forest Service. 1969. FAMULUS: a personal documentation system... Users' Manual. (revised 1971) Pacific Southwest Forest and Range Experiment Station, Berkeley, California.

Weaver, H. 1943. Fire as an ecological and sivicultural factor in the ponderosa pine region of the Pacific slope. J. For. 41:7-15.

APPENDIX 1

Summmary of species response to disturbance

* or - indicate no data + indicates increase from pre-disturbance importance

SPECIES	DISTURBANCE	SEASON OF DISTURBANCE	GROWTH PHASE	RESPONSE	MECHANISM	LOCATION	LIBRARY NUMBER
Aspen	excised roots	-	mature	+	suckering	UT	262
Aspen	cutting, bending, trenching	summer	12 year old	varied	suckering	Canada	292
Aspen	clearcut	spring	mature	+	suckering	AZ	145
Aspen	-	-	seedling	*	seed	UT	82
Aspen	cutting	-	mature	+ with good insolation	suckering	Canada	186
Aspen	wildfire	-	mature	+	suckering	MI	10
Aspen	repeated prescribed fire	spring	mature	+ and decline	suckering	MN	35
Bitterbrush	prescribed fire	January	mature	+	sprout (rare) seed	CA	216
Bitterbrush	prescribed fire	fall	mature	+ sprout	sprout seed	ID	28
Bitterbrush	clipping	fall winter	mature	+	sprout	OR WA	97
Bitterbrush	fire	-	mature	varies by location	sprout seed	INTERMT.	333
Bittercherry	prescribed fire	-	mature	+	-	ID	210
Bluebunch wheatgrass	-	-	seedling	germination	seed	WA	123
Bluebunch wheatgrass	fire	-	mature	slightly affected	-	INTERMT.	333
Bluegrass	fire	-	mature	slightly affected	-	INTERMT.	333

* or - indicate no data + indicates increase from pre-disturbance portance

SPECIES	DISTURBANCE	SEASON OF DISTURBANCE	GROWTH PHASE	RESPONSE	MECHANISM	LOCATION	LIBRARY NUMBER
Ceanothus	prescribed fire	-	mature	+	-	ID	210
Ceanothus	fire	-	seed	+	seed	INTERMT.	333
Ceanothus	clearcut	-	mature	+	-	OR WA	137
Ceanothus	wildfire	-	mature	+	soil stored seed	CA	53
Ceanothus	scarification	-	seed	+	soil stored seed	ID	54
Ceanothus	clipping	fall winter	mature	+	-	OR WA	97
Ceanothus	scarification	-	seed	varied	seed	OR	106
Ceanothus	wildfire, prescribed fire	spring fall	mature	+ and varied	sprout from root crown	ID	164
Cheatgrass	-	-	seed	germination	seed	WA	123
Cheatgrass	fire	-	mature	slightly damaged	seed	INTERMT.	333
Chokecherry	prescribed fire	fall	mature	varied	sprout	UT	93
Fireweed	wildfire	summer	mature	+	rhizome	ID	184
Gooseberry	wildfire	summer	mature	+	soil stored seed	CA	239
Gooseberry	clearcut	-	mature	+	-	OR WA	137
Horsetail	wildfire	-	-	-	rhizome	Canada	16
Huckleberry	clearcut	-	mature	+	-	OR WA	137

* or - indicate no data + indicates increase from pre-disturbance importance

SPECIES	DISTURBANCE	SEASON OF DISTURBANCE	GROWTH PHASE	RESPONSE	MECHANISM	LOCATION	LIBRARY NUMBER
Huckleberry	prescribed fire	fall	mature	+	sprout	WA	206
Huckleberry	logging	-	mature	+	sprout	ID	210
Huckleberry	prescribed fire	fall spring	mature	+	rhizome	MT	201
Huckleberry	fire	-	mature	+	sprout from root crown	INTERMT.	329
Idaho fescue	fire	all	mature	severely damaged	-	INTERMT.	333
Mountain lover	fire	-	mature	+	sprout from root crown	INTERMT.	329
Mountain ash	fire	-	mature	eliminated	seed brought by birds	INTERMT.	329
Mountain mahogany	wildfire	-	mature	killed	will not sprout	MT	221
Mountain mahogany	pruning	spring	mature	+	sprout	MT	221
Mountain mahogany	clipping	fall winter	mature	+	-	OR WA	97
Mountain mahogany	fire	-	mature	vigorous sprouter	sprout	INTERMT.	333
Mountain maple	fire	spring	mature	no change	sprout	MN	158
Ninebark	prescribed fire	spring	mature	+	sprout	MT	104

* or - indicate no data + indicates increase from pre-disturbance importance

SPECIES	DISTURBANCE	SEASON OF DISTURBANCE	GROWTH PHASE	RESPONSE	MECHANISM	LOCATION	LIBRARY NUMBER
Ninebark	clipping	June	mature	+	sprout	OR	339
Oceanspray	fire	-	mature	+	sprout from root crown	INTERMT.	329
Rabbitbrush	wildfire	summer	mature	+	sprout	NV	337
Rabbitbrush	clipping	fall winter	mature	+	-	OR WA	97
Rabbitbrush	fire, intensity important	-	mature	usually +	epicormic stem sprout	INTERMT.	333
Rabbitbrush	wildfire	summer	mature	usually sprouts	sprout from buds at root summit	WA	63
Rose	fire	-	mature	*	sprout from root crown	INTERMT.	333
Rose	prescribed fire	spring	mature	+	sprout	MT	104
Rose	-	-	mature	*	spread by rhizome	AK	66
Rose	wildfire	-	mature	*	sprout	AK	66
Sagebrush	wildfire	summer	mature	killed	seed	NV	337
Sagebrush	prescribed fire	summer	mature	killed	seed	ID	228
Serviceberry	fire	-	mature	+	sprout from root crown	INTERMT.	329

* or - indicate no data + indicates increase from pre-disturbance importance

SPECIES	DISTURBANCE	SEASON OF DISTURBANCE	GROWTH PHASE	RESPONSE	MECHANISM	LOCATION	LIBRARY NUMBER
Serviceberry	fire	-	mature	not severly damaged	sprout from root crown	INTERMT.	333
Serviceberry	prescribed fire	fall	mature	+	sprout	UT	93
Snowberry	clearcut	-	mature	+	-	OR WA	137
Snowberry	prescribed fire	fall	mature	+	sprout	UT	93
Snowberry	prescribed fire	spring	mature	+	sprout	MT	104
Snowberry	fire	-	mature	vigorous sprouter	sprout from rhizome and basal buds	INTERMT.	333
Spiraea	prescribed fire	spring	mature	+	sprout	MT	104
Spiraea	prescribed fire	-	mature	+	-	ID	210
Thimbleberry	fire	-	mature	+	sprout from root crown	INTERMT.	329
Willow	prescribed fire	-	mature	+	-	ID	210
Willow	fire	-	mature	+	sprout from root crown	INTERMT.	329

APPENDIX 2

List of keywords developed from the content of the literature contained in the Vegetative Response Library. Keywords have been organized by subject matter. An alphabetical list of the keywords has also been printed by the VOCABULARY feature of FAMULUS and is attached to the Master Bibliography.

APPENDIX 2

VEGETATIVE RESPONSE KEYWORDS

FIRE

Fall burn
Fire behavior
Fire ecology
Fire effects
Fire exclusion
Fire frequency
Fire history
Fire intensity
Prescribed fire
Spring burn
Summer burn
Underburn
Wildfire
Winter burn

FIRE EFFECTS

Duff reduction
Fire effects
Lethal temperature
Mortality
Root mortality
Survival success
Vegetative response

FUELS

Duff
Forest fuels
Litter
Slash

PRODUCTION

Biomass
Browse
Forage
Growth
Herbage

WILDLIFE

Browse
Forage
Grazing
Herbage
Wildlife

ECOLOGY

Competition
Diversity
Ecology
Life form
Model
Mosaic
Succession
Succession model

SEEDS AND SEEDBED

Cone production
Germination
Reproduction
Scarification
Seed crop
Seed dispersal
Seed production
Seedbed
Seeding
Seedlings
Seeds
Serotiny
Stratification

VEGETATIVE RESPONSE

Apical dominance
Buds
Clone
Cone production
Establishment
Germination
Growth
Layering
Management considerations
Meristem
Plant nutrients
Reproduction
Rhizome
Root crown
Roots
Seeds
Serotiny
Shoots
Sprouting
Succession
Suckering
Vegetative response

PHYSIOLOGY

Apical dominance
Buds
Clone
Legume
Meristem
Plant nutrients
Rhizome
Root crown
Roots
Seeds
Serotiny
Shoots

APPENDIX 2

VEGETATIVE RESPONSE KEYWORDS (cont'd)

PHYSICAL CHARACTERISTICS

Climate
Hydrology
Precipitation
Seedbed
Site conditions
Soil characteristics
Soil moisture
Soil nutrients
Soil temperature
Temperature

SOIL

Duff
Hydrology
Legume
Litter
Nitrogen fixation
Soil characteristics
Soil moisture
Soil nutrients
Soil temperature

SILVICULTURE

Clearcut
Logging
Management considerations
Mechanical treatment
Prescribed fire
Regeneration
Scarification
Seeding
Silvicultural treatment
Silviculture
Site preparation
Thinning

DISTURBANCE

Clearcut
Clipping
Frost damage
Herbicides
Logging
Mechanical treatment
Prescribed fire
Pruning
Scarification
Silvicultural treatment
Site preparation
Thinning

REGIONS

Canada
Intermountain West
Lake States
Northern Rocky Mountains
Pacific Northwest
Rocky Mountains
Southeast
Southwest
West

STATES

Alaska
Arizona
California
Colorado
Idaho
Illinois
Kansas
Louisiana
Michigan
Minnesota
Missouri
Montana
Nevada
New Mexico
North Dakota
Oregon
Pennsylvania
South Dakota
Tennessee
Texas
Utah
Washington
Wyoming

APPENDIX 2

VEGETATIVE RESPONSE KEYWORDS
(cont'd)

VEGETATION
Conifers
Forbs
Grasses
Grasslands
Pinyon-juniper
Range

CONIFERS
Cedar
Conifers
Douglas-fir
Engelmann spruce
Grand fir
Hemlock
Juniper
Larch
Lodgepole pine
Pinyon-juniper
Ponderosa pine
Spruce
Subalpine fir
Western white pine
White pine
Whitebark pine

DECIDUOUS TREES
Aspen
Birch
Cottonwood

FORBS
Arnica
Balsamroot
Fireweed
Forbs
Hawkweed
Horsetail
Idaho fescue
Lupine
Meadow rue
Rough fescue
Twinflower
Yarrow

GRASSES AND GRASSLIKE PLANTS
Beargrass
Bluebunch wheatgrass
Cheatgrass
Elk sedge
Grasses
Pinegrass

SHRUBS AND VINES
Alder
Bearberry
Bitterbrush
Bittercherry
Buffaloberry
Ceanothus
Chokecherry
Dogwood
Gooseberry
Honeysuckle
Huckleberry
Kinnikinnick
Menziesia
Mistletoe
Mountain ash
Mountain lover
Mountain mahogany
Mountain maple
Ninebark
Oceanspray
Oregon grape
Rabbitbrush
Rose
Sagebrush
Serviceberry
Shrubs
Snowberry
Spiraea
Strawberry
Thimbleberry
Willow

APPENDIX 3

Job Control Language (JCL) of the FAMULUS features accessed in the development of the Vegetative Response File. Commands apply only to the CDC 7600/6600 computer at Lawrence Berkeley Laboratory Computer Center. See the FAMULUS User's Manual for more detailed information on these features.

TO CREATE THE ORIGINAL FAMULUS FILE

```
JOBCARD
FETCHPS,LIBCSL,EDIT,EDIT.
FETCHPS,LIBCSL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT,D9.
LINK,X,F=EDIT,P=FM77LIB,PP=[LC=77777].
UNLOAD,EDIT,FM77LIB,TAPE1.
STAGE,TAPE2,TAPE#,QT,D9,W.
7-8-9
/ID/2108 VEGETATIVE RESPONSE FILE
/FIELDS/(AUTH,DATE,TITL,PUBL,ANNO,KEYS,NUMB,A,B,C)
/DESCRIPTOR FIELD/(KEYS)
/ORIGINAL/
/CITATIONS/
INSERT RECORDS
7-8-9
6-7-8-9
```

This feature of EDIT is used to create the original copy of the file. Do no use this routine for file maintenance or updating. Two tapes are used in creating an original FAMULUS file. One is used as an input tape (TAPE1) and the other is used as an output tape (TAPE2). The printout will list citations included in the file and indicate which citations were excluded because of format errors. Once the run is complete OK OK OK appears on the printout and the output tape becomes the input tape for the next run. DESTROY THE /ORIGINAL/ CARD.

TO ADD CITATIONS

```
JOBCARD
FETCHPS,LIBCSL,EDIT,EDIT.
FETCHPS,LIBCSL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT,D9.
LINK,X,F=EDIT,P=FM77LIB,PP=[LC=77777].
UNLOAD,EDIT,FM77LIB,TAPE1.
STAGE,TAPE2,TAPE#,QT,D9,W.
7-8-9
/ID/2108 VEGETATIVE RESPONSE FILE
/FIELDS/(AUTH,DATE,TITL,PUBL,ANNO,KEYS,NUMB,A,B,C)
/CITATIONS/
INSERT RECORDS
7-8-9
6-7-8-9
```

Two tapes are used in adding citations to an existing FAMULUS file. One is used as an input tape (TAPE1) and the other is used as an output tape (TAPE2). Once the run is complete, OK OK OK appears on the printout, and the output tape becomes the input tape for the next run. The printout will contain only those citations which were added to the file during the current run.

REPLACE

```
JOBCARD
FETCHPS,LIBCSL,EDIT,EDIT.
FETCHPS,LIBCSL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT,D9.
LINK,X,F=EDIT,P=FM77LIB,PP=[LC=77777].
UNLOAD,EDIT,FM77LIB,TAPE1.
STAGE,TAPE2,TAPE#,QT,D9.
7-8-9
/ID/2108 VEGETATIVE RESPONSE FILE
/DELETE/(1-n)  (Optional; deletes the entire record)
/REPLACE/
(RECORD#)(FIELD)*INCORRECT INFORMATION*CORRECT INFORMATION*
(RECORD#)(FIELD)**REPLACES ENTIRE FIELD WITH NEW INFORMATION*
(RECORD#)(FIELD)*DELETES SPECIFIED INFORMATION WITHIN THE FIELD**
(RECORD#)(FIELD)***  DELETES ENTIRE FIELD
7-8-9
6-7-8-9
```

Two tapes are used in making corrections to a FAMULUS file. One is used as an input tape (TAPE1) and the other is used as an output tape (TAPE2). Once the run is complete, OK OK OK appears on the printout and the output tape becomes the input tape for the next run. See the FAMULUS User's Manual for complete REPLACE formats. It is very important when making corrections to identify the unique character that is to be changed. Failure to do so may result in changes being made to material that was to remain intact.

When specifying the record number in REPLACE commands, several formats can be used:

1) (43) Makes changes in record number 43. This number is the number assigned to the record by FAMULUS. Some FAMULUS files contain a number field which is used to identify publications in a library. Do not use the library number when using REPLACE.

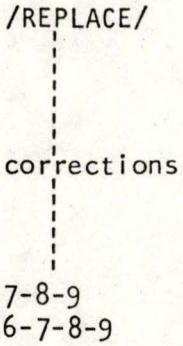
2) (35-40) Makes specified changes where material to be changed occurs in records 35-40.

3) (35,40) Interpreted exactly as 2 above.

4) (23,76,83) This sequence will not be interpreted by REPLACE.

The run will abort and no changes will be made.

Use only one /REPLACE/ card at the beginning of the corrections.



INDEX

```
JOBCARD
FETCHPS,LIBCSL,INDEX,INDEX.
FETCHPS,LIBCSL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT,D9.
LINK,X,F=INDEX,P=FM77LIB,PP=[LC=77777].
UNLOAD,INDEX,FM77LIB,TAPE1.
7-8-9
/ID/VEGETATIVE RESPONSE FILE
/FIELDS/(Field to be indexed - one only. Default is the descriptor
         field.  Enclose field in parentheses.)
7-8-9
6-7-8-9
```

INDEX provides a list of terms occurring in the specified field, along with the FAMULUS numbers of the citations in which the individual terms occur. Only one field may be specified for an INDEX run. If no field is specified, INDEX will default to the descriptor field. Terms to be indexed must be separated by commas. Blanks are ignored. Only one tape (Master Tape - TAPE1) is used with INDEX. Examples of formats used with INDEX are:

```
AUTH SMITH J.D., DOE B.D., PUBLIC M.A.
AUTH JONES S.C.
KEYS FIRE, SMOKE, FUEL, FIRE EFFECTS, SMOKEY BEAR
```

Note: Do not use the word 'and' in the AUTH field if it is to be indexed.

SORT

```
JOBCARD
FETCHPS,LIBCSL,SORT,SORT.
FETCHPS,LIBSCL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT.D9.
LINK,X,F=SORT,P=FM77LIB,PP=[LC=77777].
UNLOAD,SORT,FM77LIB,TAPE1.
STAGE,TAPE2,TAPE#,QT,D9,W.
7-8-9
/ID/2108 VEGETATIVE RESPONSE FILE
/FIELDS/(List fields in the order in which they are to be arranged.
        The Vegetative Response File is ordered:  AUTH,DATE,TITL,
        PUBL,ANNO,NUMB,A,B,C).
7-8-9
6-7-8-9
```

Two tapes are used with SORT. One is used as an input tape (TAPE1) and the other is used as an output tape (TAPE2). Once the run is complete OK OK OK appears on the printout and the output tape becomes the input tape for the next run. SORT rearranges both the fields within the citations and the entire file. Fields within citations are arranged to meet the criteria set by the /FIELDS/ card. The order of the fields within records will be changed if the original order is altered in the /FIELDS/ card. Each record is alphabetized on the basis of the information on the /FIELDS/ card. For example, the Vegetative Response File is alphabetized by author, date, title, etc. Use the original fields order to re-alphabetize the file after adding new citations to the file through the EDIT feature. Enclose the fields in parentheses, as shown, and separate them with commas. Following a SORT, EDIT or GALLEY must be accessed to get a listing of the updated file.

SEARCH

```
JOBCARD
FETCHPS,LIBCSL,SEARCH,SEARCH.
FETCHPS,LIBCSL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT,D9.
LINK,X,F=SEARCH,P=FM77LIB,PP=[LC=77777].
UNLOAD,SEARCH,FM77LIB,TAPE1.
7-8-9
/ID/2108 VEGETATIVE RESPONSE FILE
/FIELDS/(Field or fields to be searched)
/SEARCH/Search Formula - see FAMULUS User's Manual
7-8-9
6-7-8-9
```

Search is used to retrieve citations that satisfy the conditions set within the SEARCH Formula (see FAMULUS User's Manual). Only one tape (Master Tape - TAPE1) is used for SEARCH. SEARCH is very forgiving of blanks between words in the SEARCH Formula.

Card punch codes for special characters at BKY:

AND	$\wedge$	0-7-8 multipunch
OR	$\vee$	11-0 multipunch
NOT	$\neg$	12-8-6 multipunch

The negation (NOT) symbol is currently interpreted incorrectly by the remote batch terminal at NFFL. Use of this operator causes the program to abort.

TO GET A LISTING

```
JOBCARD
FETCHPS,LIBCSL,EDIT,EDIT.
FETCHPS,LIBCSL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT,D9.
LINK,X,F=EDIT,P=FM77LIB,PP=[LC=77777].
UNLOAD,EDIT,FM77LIB,TAPE1.
7-8-9
/ID/2108 VEGETATIVE RESPONSE FILE
/PRINT/(1-n)  (Specifies records to be printed)
7-8-9
6-7-8-9
```

Only one tape (Master Tape - TAPE1) is used with this option of EDIT. The printout consists of a listing of the records requested. The /PRINT/(1-n) card must be used to get a list of the complete file where n equals the total number of records in the file. To print specific citations, simply list the numbers; /PRINT/(16,20-23,84). It is useful to access this feature after new records are added to the file or following a SORT run. GALLEY also has the capability to print the contents of the file in any of several different formats.

VOCABULARY

```
JOBCARD
FETCHPS,LIBCSL,INDEX,INDEX.
FETCHPS,LIBCSL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT,D9.
LINK,X,F=INDEX,P=FM77LIB,PP=[LC=77777].
UNLOAD,INDEX,FM77LIB,TAPE1.
7-8-9
/ID/2108 VEGETATIVE RESPONSE FILE
/THREE COLUMN/  (Optional; /TWO COLUMN/ may also be used and
                 simply specifies the format in which the output
                 will be printed.)
/VOCABULARY/(Field)   (Specify field from which the vocabulary is to
                       be produced.)
7-8-9
6-7-8-9
```

VOCABULARY provides an alphabetical list of all terms occurring in the specified field. It is useful in determining keywords that will be used in the construction of a SEARCH Formula. Only one tape (Master Tape - TAPE1) is used with VOCABULARY. It is important that the /THREE COLUMN/ card (if used) follow the /VOCABULARY/(Field) card.

GALLEY

```
JOBCARD
FETCHPS,LIBCSL,GALLEY,GALLEY.
FETCHPS,LIBCSL,FM77LIB,FM77LIB.
STAGE,TAPE1,TAPE#,QT,D9.
UNLOAD,GALLEY,FM77LIB,TAPE1.
7-8-9
/ID/2108 VEGETATIVE RESPONSE FILE
/SELECT/(Optional; designates which records are to be printed.
        Enclose record numbers in parentheses.)
/FIELDS/(Optional; specifies which field or fields are to be
        printed.  Enclose field names in parentheses.)
/NUMBERS/(1-n)  (Optional; provides for printing of records without
                 their FAMULUS numbers.  Individual records may also
                 be specified; /NUMBERS/(1,4-6,8).)
/INTRO/  (Optional; must be the last card in GALLEY JCL if it used.
          Follow it with any desired file introduction, enclosed in
          parentheses.  There are no keypunching restrictions when
          developing an INRO text.
7-8-9
6-7-8-9
```

GALLEY is the primary printing routine of FAMULUS. It allows printing of the file in any of several formats. It uses only one tape (Master Tape - TAPE1). Some of the available options of GALLEY are described above; see the FAMULUS User's Manual for additional options.